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L A S A

SIGNAL PROCESSING, SIMULATION, AND COMMUNICATIONS STUDY

VOLUME II

Addendum To First Quarterly Technical Report

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DEPUTY FOR ADVANCED PLANNING
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
United States Air Force
L.G. Hanscom Field, Bedford, Massachusetts

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LASA SIGNAL PROCESSING,
SIMULATION, AND COMMUNICATIONS STUDY

ADDENDUM TO

First Quarterly Technical Report,
For the Period February 14 - May 14, 1966

Prepared For:
Electronic Systems Division
L. G. Hanscom Field, Mass.
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CONTENTS

	<u>Page</u>
1. SYSTEM PERFORMANCE STUDY	1
2. SIGNAL AND NOISE SIMULATION	2
3. BEAM COVERAGE ANALYSIS	2
4. STEERING DELAY STUDY	3
5. POST DETECTION AND LOCALIZATION STUDY	3
6. SPECIFICATION OF EXPERIMENTAL PROCESSING SYSTEM DISPLAY	4
7. DIGITAL FILTERING	4
8. ANALYSIS OF SHEAR WAVE RECEPTION	5

OTHER WORK IN PROGRESS AND PLANNED

The main part of the Quarterly Technical Report is a definition of a signal processing system for LASA suitable for experimental verification of processing techniques. This addendum summarizes that part of the current and planned effort being carried out in support of that system definition and omitted from the main report. The following tasks will be summarized.

- System Performance Study
- Signal and Noise Simulation
- Beam Coverage Analysis
- Steering Delay Study
- Post Detection and Localization
- Display Simulation
- Digital Filtering
- Analysis of Shear Wave Reception

1. SYSTEM PERFORMANCE STUDY

Purpose

To predict the signal gain at the subarray and LASA levels, obtainable for typical signals from beam forming and filtering operations; verify the effects of varying levels of quantization on gain; and determine the filtering band for maximum gain improvement.

Status

A number of programs have been written, and several have been debugged, to provide an off line capability for beam forming, filtering, thresholding, rectifying/ integrating, and calculating signal power and array gain.

Plans

Complete the programming and debugging as described above, and use these programs on typical signals obtained from the LASA array.

2. SIGNAL AND NOISE SIMULATION

Purpose

To further optimize system characteristics for weak signals in the presence of noise, particularly those relating to detection logic and event localization (see part 5).

Status

To be programmed when the programs of part 1 are operational.

Plans

Write programs for simulating "weak signals" by artificially combining LASA signal records with noise records. Test these records on the programs discussed in parts 1 and 5.

3. BEAM COVERAGE ANALYSIS

Purpose

To provide a simple method of determining beam coverage requirements as a function of geographic position of a receiving station, frequency, and the particular portions of the corresponding teleseismic zone to be covered.

Status

This task has been essentially completed for the Montana LASA location. Beam counts under various conditions for LASA are discussed in the main report.

The mapping program that has been used is ready to run for any other receiver location.

Plans

Document the beam counting technique; analyze other receiver locations as required.

4. STEERING DELAY STUDY

Purpose

To arrive at an initial set of steering delays to be set into the LASA detection system.

Status

Programs for analyzing seismic arrival time data have been written and tested on a limited set of data from the Tonto Forest Seismic Observatory. These programs consist of a Least Squares Wavefront Program to determine signal velocity and azimuth, and another program for providing statistical time anomaly information for a number of wave fronts.

Plans

Modify, extend, and apply these programs as planned to LASA arrival time data.

5. POST DETECTION AND LOCALIZATION STUDY

Purpose

To develop methods of obtaining and selecting the best event beam, determine the location of the event therefrom; and evaluate the efficacy of an event beam display for event beam selection.

Status

While some possible methods for post detection processing can be noted, they must yet be evaluated to determine the adequacy of a display solution.

Plans

Write programs for forming clusters of event beams centered on a detection beam, determine the "strongest" of these event beams, and perhaps calculate moments and center of gravity of clusters of beams. Use these programs as inputs to a simulated display.

6. SPECIFICATION OF EXPERIMENTAL PROCESSING SYSTEM DISPLAY

Purpose

If warranted by the results of part 5, develop specifications for a display system that can be used to show detection and event beam distributions resulting from typical seismic events, and that can be used to test post-detection programming methods.

Status

No progress to report.

Plans

Timely progress on part 5 will govern these efforts.

7. DIGITAL FILTERING

Purpose

To program filters for checking the adequacy of general and recursive filters of various orders for the signal processing system (see parts 1 and 2 above).

Status

Programs for filter implementation and coefficient calculation have been partially written. The effect of filter-generated roundoff error, as well as of filter coefficient accuracy on system performance is being analyzed.

Plans

Complete and debug programs to be used in parts 1 and 2 above.

8. ANALYSIS OF SHEAR WEAWE RECEPTION

Purpose

To determine additional beam forming and filtering requirements for processing shear waves and perhaps core-reflected phases.

Status

No significant effort has been made.

Plans

By ray tracing, ascertain the range of shear wave horizontal phase velocity, estimate typical time delays for shear arrival beam forming, and establish appropriate filtering requirements from anticipated shear wave spectral content.

